

REMARKS

Claims 1, 4, 10, 13 and 16-25 are presently pending in the application.

Claim 1 has been amended to incorporate the subject matter from claim 7, which has been canceled. No new matter has been added by this amendment. Moreover, no new issues are raised by the amendment, so that entry after final is proper.

At the outset, Applicants acknowledge and appreciate the time and courtesy afforded to Applicants' representatives William Schwarze and Sandra Katz during a telephone interview on January 13, 2004. As a result of this interview, the Examiner indicated that he had a better understanding of Applicants' arguments regarding amended claim 1, discussed in further detail below. Applicants' arguments are summarized and supplemented below.

Rejections Under 35 U.S.C. § 103(a) Based On JP '701 and JP '508, Alone or in View of Kato or Ikoma

Claims 16-25 have been previously allowed by the Examiner. For the reasons discussed previously, claims 1 and 4 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 11-219701 ("JP '701") in view of JP 08-203508-A ("JP '508"). Further, claim 7 has been rejected under § 103(a) as being unpatentable over JP '701 in view of JP '508 in further view of U.S. Patent No. 6,083,642 of Kato ("Kato") and claims 10 and 13 have been rejected under § 103(a) as being unpatentable over JP '701 in view of JP '508 in further view of U.S. Patent No. 4,837,119 of Ikoma. The Examiner's basis for rejection and Applicants' arguments, which are relied upon in full, were described in detail in the Request for Reconsideration filed September 17, 2003 and will not be repeated here.

In the Advisory Action dated October 1, 2003, the Examiner argues that the Request for Reconsideration does not place the application in condition for allowance because it fails to provide convincing evidence that the prior art rejection of record does not render the claimed invention obvious. Namely, in response to Applicants' previous argument that JP '508

is drawn to negative electrode materials and not positive electrode materials as recited in the present claims and in JP '701, the Examiner contends that JP '508 provides a teaching that by selecting the nickel hydroxide valence in an electrode of a rechargeable battery, the charging and discharging characteristics of the battery can be improved. The Examiner argues that one of ordinary skill in the art would have found such a teaching to be equally applicable to either positive or negative electrodes in rechargeable batteries which employ nickel as an active material for the purpose of optimizing the charge and discharge characteristics of the electrode having nickel as an active material. Furthermore, the Examiner contends that given the ranges of nickel hydroxide (90-60 weight %) to nickel oxyhydroxide (10-40 weight %), the nickel in the hydroxide has a charge of +2 and the nickel in the oxyhydroxide has a charge of +3. Given the ranges set forth therein (about 60% from the hydroxide and about 40% from the oxyhydroxide), the Examiner concludes that the average oxidation number of the nickel in the electrode will be above 2.5, and close to or slightly above 2.6, which is within the critical range disclosed in the application.

While not necessarily agreeing with the Examiner's conclusions, independent claim 1 has been amended to recite that the cobalt in the cobalt oxyhydroxide in the first and second active materials has a valence greater than about 3.

The Examiner has previously acknowledged that JP '701 and JP '508 do not teach that the oxidation number of the cobalt in the oxyhydroxide in the active materials is greater than 3, but argued that Kato discloses a process in which the nickel active material is coated with cobalt having an oxidation number greater than 3, and that using a higher valence cobalt material provides a positive electrode material having high active material utilization and improved overdischarge withstanding characteristics. Therefore, the Examiner concluded that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the

teachings of JP '701 by providing a higher valence cobalt material to provide such favorable properties. Applicants respectfully traverse this rejection as it now applies to claim 1 for the reasons set forth previously and for the additional reasons which follow.

The present invention is directed principally to pursuing the reduction of the discharge reservoir of a battery as compared with conventional batteries. Applicants have found that this goal may be achieved perfectly by utilizing a combination of cobalt oxyhydroxide having a cobalt valence greater than 3 in the active materials and nickel having an oxidation number of ≥ 2.6 and ≤ 2.92 . Further, the use of such cobalt oxyhydroxide provides several advantages over prior art batteries.

First, if the valence of cobalt is initially less than 3, it may change to 3 during charge/discharge cycles, resulting in the undesirable production of a discharge reservoir while the valence of cobalt is changing to 3 in the battery (see specification page 3, line 22 to page 4, line 4). On the other hand, if cobalt oxyhydroxide with a valence of cobalt greater than 3 is used initially, the valence does not change and the formation of such an excessive discharge reservoir can be eliminated.

Second, since cobalt oxyhydroxide with a cobalt valence greater than 3 is very stable throughout the long cycle of charge/discharge, it is possible to prevent changes of the discharge reservoir resulting from cobalt valence changes, as well as to accurately maintain the discharge reservoir to be an appropriate small amount throughout the long cycle.

Finally, the utilization rate of the second active material can be improved by using cobalt oxyhydroxide with a cobalt valence greater than 3. In order to efficiently obtain the second active material, the first active material is used as the starting material and then subjected to an oxidation treatment to obtain the second active material. If the valence of cobalt in the surface layer of the first active material is 3 or lower, the utilization rate of the second active

material will become low compared with the utilization rate of the starting first active material. This may be because the cobalt with a valence of 3 or lower adversely affects the produced second active material.

In contrast, if the valence of cobalt in the surface layer is greater than 3, for example 3.12 or 3.19, the second active material utilization rate is almost the same as that before the oxidation. The cobalt compound with a cobalt valence greater than 3 has a structure in which alkali metal ions are intercalated between the layers, and is thus more stable than that with a valence of 3 or lower.

In summary, by using cobalt oxyhydroxide with a cobalt valence greater than 3 combined with regulating the mean valence of nickel, according to the present invention, it is possible to:

- (a) eliminate the excessive discharge reservoir due to the valence change of cobalt;
- (b) avoid the variation in the discharge reservoir throughout the long cycle; and
- (c) prevent the second active material utilization rate from decreasing.

Kato teaches coating nickel active material with cobalt having an oxidation number greater than 3 for providing a high active material utilization rate and improved overdischarge withstanding characteristics. However, Kato does not teach or suggest that regulating the valence of cobalt in cobalt oxyhydroxide would additionally stabilize the cobalt oxyhydroxide, which significantly affects and optimizes the discharge reservoir. Accordingly, it would not be expected based on the proposed combination that to apply cobalt oxyhydroxide with a valence of cobalt of greater than 3 to JP '701 and JP '508, combined with regulating the mean valence of nickel contained in the positive electrode as claimed, would (a) eliminate the

excessive discharge reservoir due to the valence change of cobalt; (b) avoid the variations in the discharge reservoir; and (c) prevent the second active material utilization rate from decreasing.

Additionally, as previously demonstrated, it would not be expected based on the proposed combination of references that the amount of the discharge reservoir of the negative electrode can be optimized by regulating the mean valence of nickel in the positive electrode. As a result, it is possible to reduce the amount of expensive hydrogen storage alloy to be used, thus enabling the production of a low-cost battery with a high energy density (page 31, lines 6 to 11). For example, a battery with a discharge reservoir of not greater than 10% (such as recited in claim 13 and described at page 27, line 17 to page 28, line 16 and in Tables 1 and 2) can be produced. As shown in Tables 1 and 2, the batteries according to the present invention (1, 2, and 3) exhibited favorable properties relative to the comparative examples, which is due in part to the difference in oxidation number of nickel in the positive electrodes. It is noted that Comparative Example 13 is the example from JP '701, which is clearly inferior to the presently claimed electrodes. This demonstrates the superiority of the present invention over the prior art.

For these reasons, even if a *prima facie* case of obviousness had been established by the Examiner based on any of the proposed combinations of references, it would be overcome by all of the unexpected results exhibited by the present invention. Accordingly, reconsideration and withdrawal of the § 103(a) rejections are respectfully requested.

Based on the preceding Amendments and Remarks, it is respectfully submitted that the pending claims are patentable, distinct from the prior art of record, and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,
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